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A NEW SPECIES OF *ANTHESSIUS* (COPEPODA: POECILOSTOMATOIDA) ASSOCIATED WITH *BERTHELLA STELLATA* (RISSO, 1826) (GASTROPODA: OPISTHOBRANCHIA)

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Abstract.—Only four species of the genus *Anthessius* Della Valle, 1880 are known to be associated with notaspidean molluscs. Only *A. pleurobrancheae* Della Valle, 1880 has been reported in European waters, and has not been seen since the original description. In this paper, *A. arcuatus,* associated with *Berthella stellata* (Risso, 1826) from Spanish waters, is described and compared with other congeneric species associated with notaspidean molluscs. The diagnostic characters of this species are the second maxilla, the labrum, and leg 5.

The fauna of copepods associated with invertebrates is relatively unknown in the Iberian Peninsula. Although the majority of this fauna is probably scientifically known and reported from the European and North African coasts, it is likely that, during the next few years, new species will be described from material obtained in the Iberian Peninsula.

During the Marine Biology Expedition "Bahía'90" in Algeciras Bay (Cádiz, Spain), some specimens of the genus *Anthessius* were collected from the gills of four specimens of the notaspidean *Berthella stellata* (Risso, 1826).

A close examination of these copepods revealed that they do not correspond to Della Valle's (1880) *Anthessius pleurobrancheae.* In the course of studying this species, several synapomorphies were discovered in the species of *Anthessius* that are normally associated with sea slugs of the Order Notaspidea. Therefore, a discussion on this matter will be given following the description of the new species.

Materials and Methods

The opisthobranch molluscs were collected under stones from intertidal and upper infralittoral zones. These specimens were maintained in separate glass bottles. The copepods were taken from the gills and pallial cavity of sea slugs and were preserved in a solution of ethyl alcohol (70% in seawater). The specimens were dissected under a stereomicroscope and semipermanent mounts were made using CMC 10 and lignin pink. All figures have been drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn.

Family Anthessiidae Humes, 1985
Genus *Anthessius* Della Valle, 1880
Anthessius arcuatus, new species
Figs. 1–4

Type material.—4 ♀♀, 2 ♂♂ and 3 copepodites from the gills of 4 specimens of the opisthobranch mollusc *Berthella stellata* (Risso, 1826) in El Campamento (San Roque), Algeciras Bay, Cádiz, Spain, 7 Jul 1990.

Female.—Body (Fig. 1a, b) cyclopiform, length (not including setae on caudal rami) 1.79 mm (1.75–1.82 mm) and greatest width 1.01 mm (1.00–1.02 mm) based on 4 specimens in 70% ethyl alcohol. Ratio of length to width of prosome 0.72:1. Ratio of length

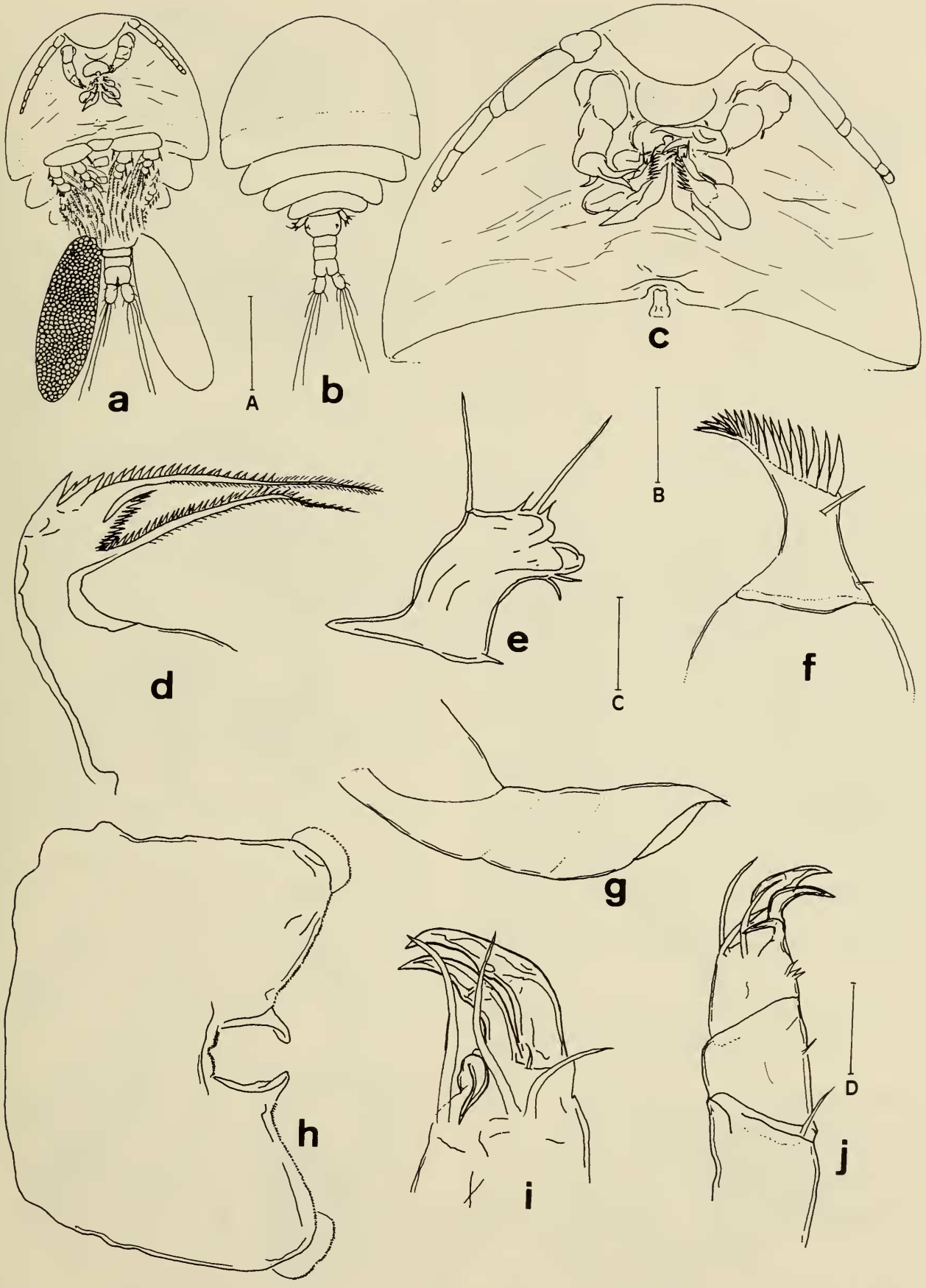

Fig. 1. *Anthessius arcuatus,* new species. Female: a, ventral (A); b, dorsal (A); c, cephalotorax, ventral (B); d, mandible (C); e, first maxilla (C); f, second maxilla (C); g, maxilliped (C); h, labrum and paragnaths, ventral (C); i, tip of second antenna, posterior (D); j, second antenna (C). Scale: A, 550 μm; B, 170 μm; C, 50 μm; D, 100 μm.

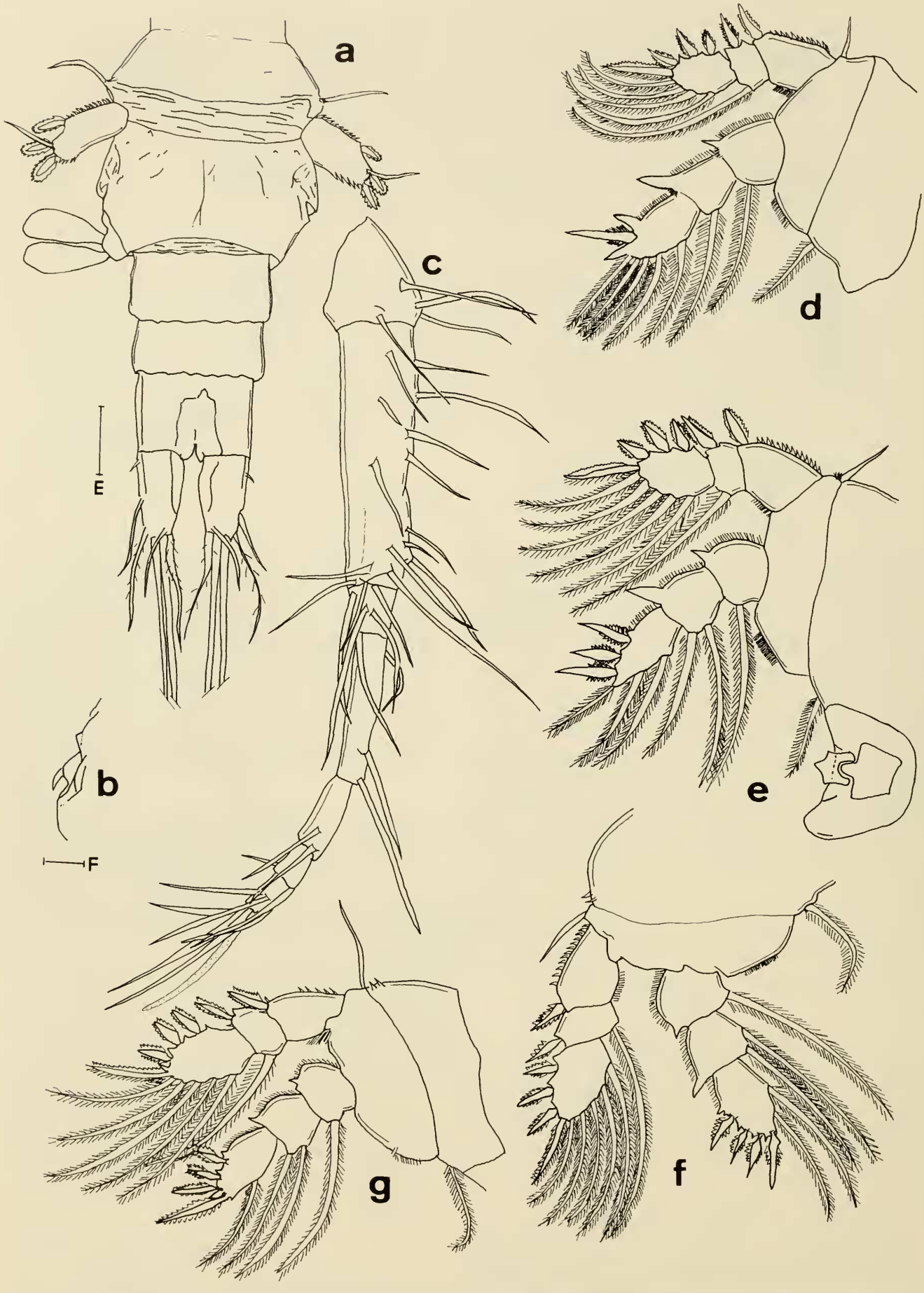

Fig. 2. *Anthessius arcuatus,* new species. Female: a, urosome, dorsal (E); b, egg sac, attachement area, dorsal (F); c, first antenna, dorsal (D); d, leg 1, anterior (D); e, leg 2 and intercoxal plate, anterior (D); f, leg 3, anterior (D); g, leg 4, anterior (D). Scale: E, 100 μm; F, 12 μm.

of prosome to that of urosome 1.43:1. Segment of leg 1 separated dorsally from head by transverse furrow. Segment of leg 5 (Fig. 2a) 300 × 150 μm. Genital segment wider than longer, 160 × 300 μm; mid-region with dorsal longitudinal suture about three-fourths length of genital segment (Fig. 2a). Genital areas located dorsolaterally, just posterior to widest part of segment. Each area (Fig. 2b) without seta, with a small spiniform process about 3 μm long. Two postgenital segments from anterior to posterior 90 × 200 μm, 70 × 180 μm, and the anal segment 110 × 160 μm. Caudal ramus 115 × 60 μm, 2× longer than wide bearing 6 setae. One anterior lateral setule is 3 μm and naked. Outer posterior lateral seta 150 μm and naked, dorsal seta 70 μm and naked, outermost terminal seta 180 μm, innermost terminal seta 200 μm, and the two long median terminal setae 440 μm (outer) and 730 μm (inner). Medial margin caudal ramus convex.

Egg sac elongate, 1.25 × 0.38 mm, extending beyond tips of longest ramal setae, and containing numerous eggs, each about 50 μm in diameter.

Rostrum (Fig. 1c) rounded posteroventrally.

First antenna (Fig. 2c) about 444 μm long. Lengths of 7 segments (measured along their posterior non-setiferous margins): 20 (90 μm along anterior margin) 175, 32, 105, 52, 30 and 30 μm; respectively. Formula for armature 4, 15, 4, 4, 2, 2 and 7 + 1 aesthetes. All setae naked.

Second antenna (Fig. 1j, i) 3-segmented. Formula for armature: 1, 1, and 6 + 1 setule + two claws + one claw-like process. Third segment, 100 μm along its outer edge, 90 μm along its inner edge and 90 μm wide, bearing 3 short setae on inner side, 3 long setae on outer side, 2 claws (100 and 89 μm, respectively) and a claw-like process 35 μm. All elements naked.

Labrum (Fig. 1h) with 2 broad posteroventral lobes, separated by a deep arch, with pair of digitiform processes medially; posterior edge of lobes and the inner edge of the arch denticulated. Paragnates presents, denticulated.

Table 1.—Armature of legs. (Roman numerals = spines; Arabic numerals = setae; exp = exopod; end = endopod.)

	Leg	Coxa	Basis	Armature
♀♀	1st	0–1	1–0	exp: I–0; I–1; III,I,4 end: 0–1; 0–1; I,5
	2nd	0–1	1–0	exp: I–0; I–1; III,I,5 end: 0–1; 0–2; III,3
	3rd	0–1	1–0	exp: I–0; I–1; III,I,5 end: 0–1; 0–2; IV,2
	4th	0–1	1–0	exp: I–0; I–1; III,I,5 end: 0–1; 0–2; IV,1
♂♂	1st	0–1	1–0	exp: I–0; I–1; III,I,4 end: 0–1; 0–1; II,4

Mandibule (Fig. 1d) with concave side having an incision, followed by two long prominent spinulose lashes; between these, a denticulate process; convex with strong denticles. First maxilla (Fig. 1e) bilobed, with outer lobe bearing 2 long setae, each 65 μm and 2 short setae, each 10 μm; inner lobe with only 2 setae, 60 and 62 μm. All elements naked. Second maxilla (Fig. 1f), 2-segmented; first segment unornamented; second segment bearing denticulated lash, with small setule on its proximal outer surface and posterior seta. Maxilliped (Fig. 1g) 3-segmented, greatly reduced, the pointed distal segment bears a small subterminal seta.

Area between maxilliped and first pair of legs with well-defined line, slightly protuberant.

Legs 1–4 (Fig. 2d–g) with 3-segmented rami. Formula for armature in Table 1.

Inner coxal setae are pinnate. Row of spinules on lateral margin of first exopodal segment of legs 1–4. Inner margin of basis of legs 1–4 with row of spinules.

Leg 5 (Fig. 2a) with free segment, 115 × 50 μm, with anterior and posterior borders denticulated, and carrying 3 serrated spines and 1 naked dorsal seta. Segment of leg 5 with a naked seta, 90 μm long.

Male.—Body very similar to that of fe-

male (Fig. 3a, b). Length (excluding setae on caudal rami) 1.33 mm and greatest width 0.69 mm, based on 2 specimens in 70% ethyl alcohol. Ratio of length to width of prosome 0.64:1. Ratio of length of prosome to that of urosome 1.13:1.

Segment of leg 5 (Fig. 4a) 100 × 210 μm. Four postgenital segments from anterior to posterior 50 × 160 μm, 60 × 140 μm, 40 × 135 μm and 70 × 125 μm (Fig. 4a).

Caudal ramus resembling that of female, 95 × 55 μm, with ratio 1.72:1 (Fig. 4c).

Rostrum rounded posteroventrally. First antenna (Fig. 3i) similar to that of female, but three additional aesthetes on second segment, resulting in formula of 4, 15 + 2 aesthetes, 4 + 1 aesthete, 4, 2, 2 and 7 + 1 aesthete.

The second antenna (Fig. 3j) is similar to that of female, but inner side of third segment bearing 4 short setae, 3 long setae on outer side, 2 claws, and a claw-like process. All elements naked.

Labrum, mandible, paragnaths, first maxilla and second maxilla (Fig. 3c–f) like those of female. Maxilliped (Fig. 3g, h) 4-segmented; first segment bearing a setose area near union with second segment; second segment with 2 long setae, 3–7 rows of spines on inner side and 3 short spinules near insertion of third segment, which has 2 setae; claw 200 μm with concave edge denticulate and short seta.

Legs 1–4 (Fig. 4e–i) with similar spinal and setal formula as in female, except third segment of endopod of leg 1 (Fig. 4f) (formula in Table 1).

Leg 5 (Fig. 4b) free segment 105 × 50 μm, similar to that of female.

Leg 6 (Fig. 4d) consisting of posteroventral flap on genital segment and bearing 2 naked setae, 45 μm and 30 μm, and spiniform process.

Spermatophore 120 × 50 μm.

Sexual dimorphism.—The spines of the third endopod segment of all the legs are different in each sex. These spines are acutely lanceolate and denticulate in their proximal half in the female, but in the male they are large, more blunt and slightly denticulate along the entire length.

Etymology.—The specific name *arcuatus,* from Latin *arcuatus* = arch shaped, alludes to the characteristic posterior region of the labrum. The holotype has been deposited in the Museo Nacional de Ciencias Naturales de Madrid (Spain) (MNCNM 20.04/2722).

Discussion

The genus *Anthessius* has been included in various families since its original description by Della Valle (1880) e.g., Lichomolgidae (Stock 1959, Humes & Ho 1965, Humes 1973) and Myicolidae in Stock et al. (1963) following the opinion of Illg (1960). The latter designation has been accepted by other authors (Humes & Stock 1965; Humes 1973, 1976; Ho 1983). Recently, Humes (1985) created the family Anthessidae with *Anthessius* as type genus, with four other genera, *Katanthessius, Neanthessius, Panaietis* and *Rhinomolgus.*

Of all species belonging to *Anthessius* associated with notaspidean molluscs, only *A. pleurobrancheae* Della Valle, 1880 was known in European waters. This species was collected on *Pleurobranchaea* sp. in Napoles, and was never reported again.

Ho (1983) recognized two different groups among the 34 species of the genus *Anthessius*: one group is found in pelecypods and the other associated with notaspidean sea slugs. The members of the latter group have five features in common: 1) a second antenna armed with three terminal spines; 2) a mandible bearing a short dentate lamella between the bases of the apical lash and the setiform element; 3) a second maxilla armed with a large number of teeth (at least ten) in the terminal process; 4) the last segment of leg 4 exopod having a formula of III, I, 5; and 5) the endopods of legs 2 through 4

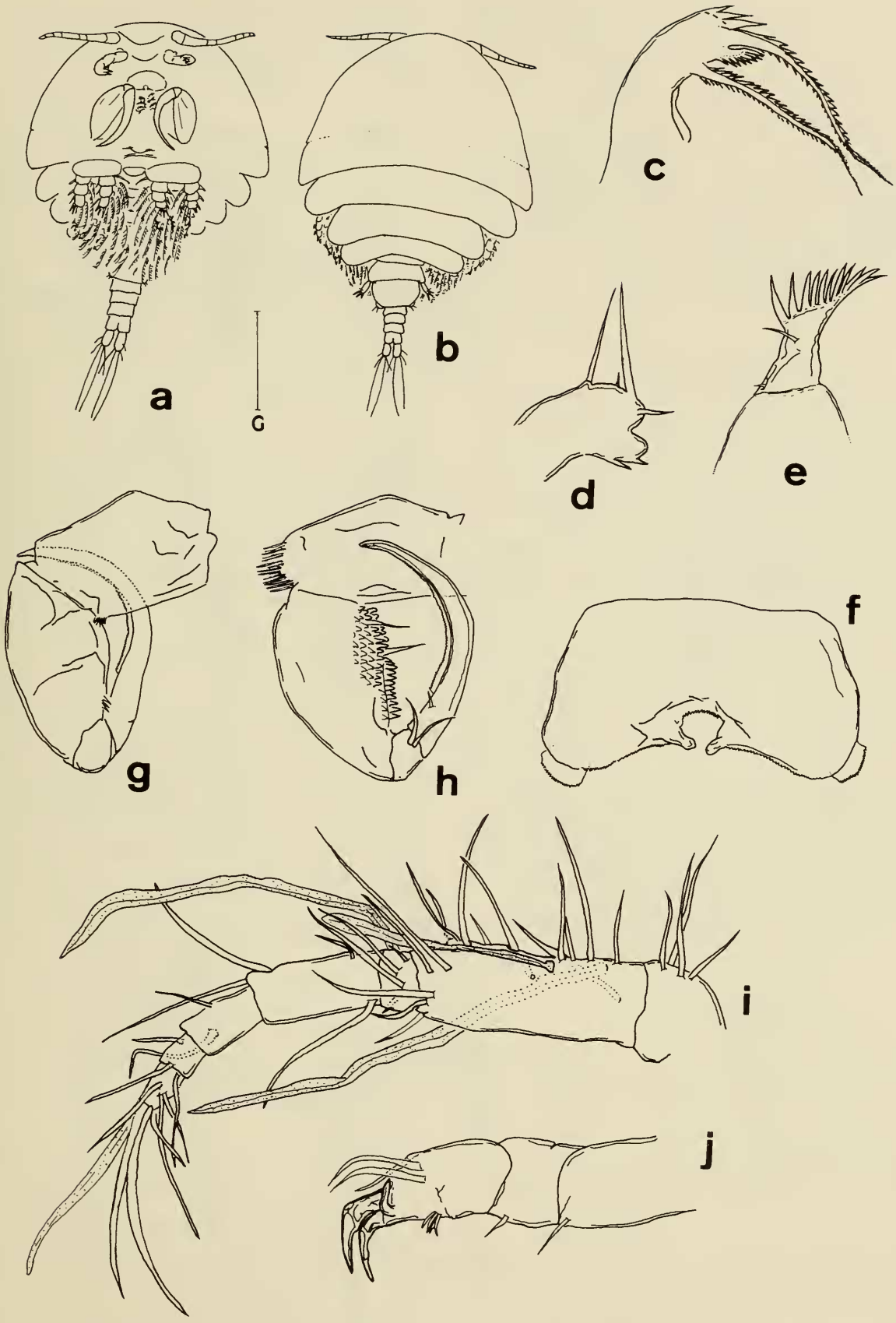

Fig. 3. *Anthessius arcuatus,* new species. Male: a, ventral (G); b, dorsal (G); c, mandible (C); d, first maxilla (C); e, second maxilla (C); f, labrum and paragnaths, ventral (C); g, maxilliped, outer; h, maxilliped, inner; i, first antenna, dorsal (D); j, second antenna, posterior (D). Scale: G, 420 μm.

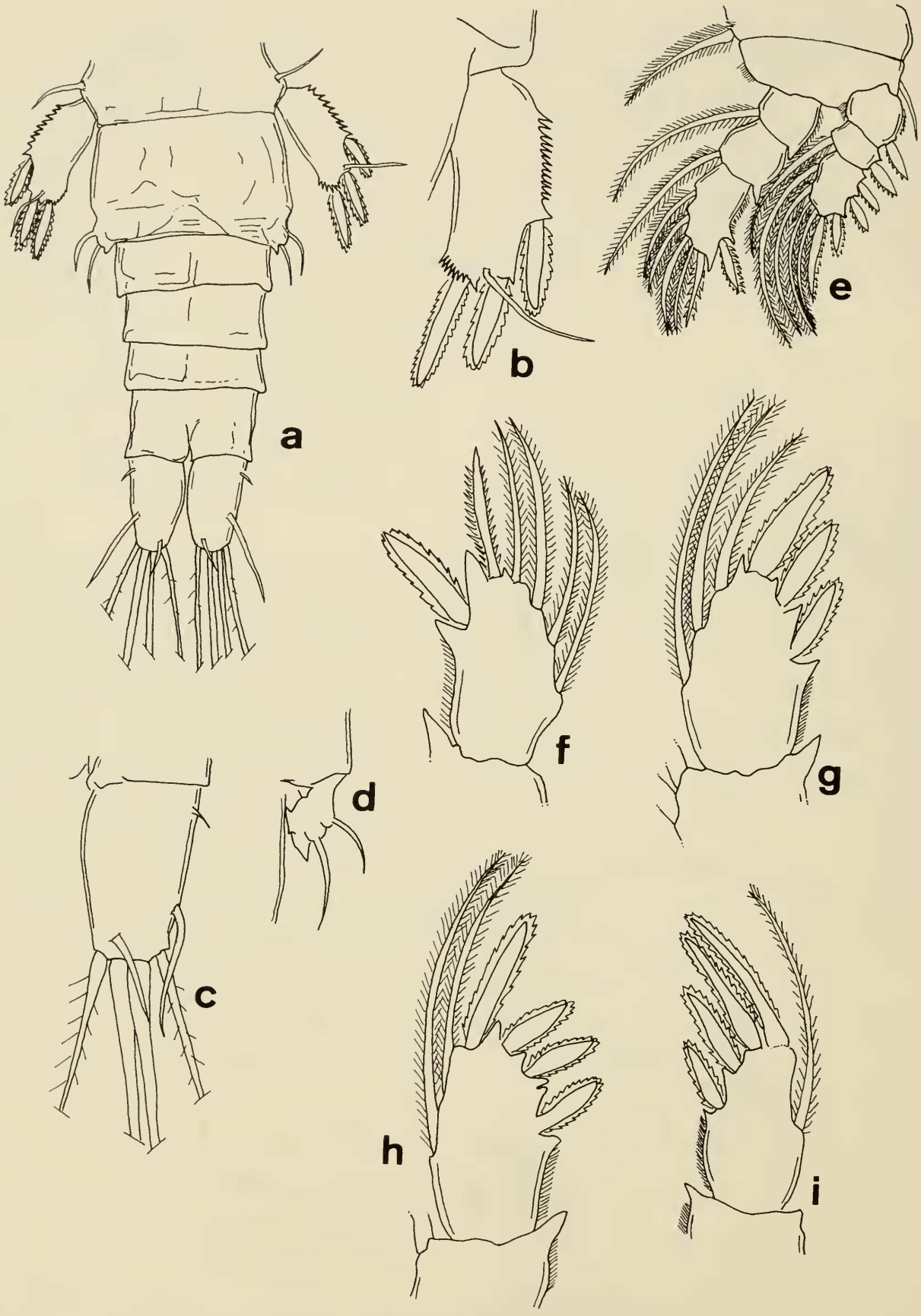

Fig. 4. *Anthessius arcuatus,* new species. Male: a, urosome, dorsal (E); b, leg 5, dorsal (C); c, caudal ramus, dorsal (C); d, leg 6, ventral (C); e, leg 1, ventral (D); f, terminal endopodal segment of leg 1 (C); g, terminal endopodal segment of leg 2 (C); h, terminal endopodal segment of leg 3 (C); i, terminal endopodal segment of leg 4 (C).

in the male bearing obtuse and smooth (instead of pointed and denticulate) spines (Ho 1983). *A. arcuatus* also has these five characteristics.

The *Anthessius* associated with notaspidean are: *A. pleurobrancheae* Della Valle, 1880, *A. hawaiiensis* (Wilson, 1921), *A. ovalipes* Stock et al. 1963 and *A. obtusispina* Ho, 1983. The most important difference among these species and *A. arcuatus* are the form of the two posteroventral lobes of the labrum. Furthermore, *A. ovalipes* has a prominent and well-defined postoral protuberance that our species does not have. *A. obtusispina* is very different, i.e., the mandible has a short dentate lamella between the apical lash and the long setiform element, the inner lobe of the first maxilla bears only one short, stubby element, the pointed distal segment of the maxilliped of the female bears a small subterminal seta, and leg 5 is armed with 3 slender setiform spines. The second maxilla of *A. hawaiiensis* has a low apical sclerotized portion, not inclining anteriorly in a marked angle to the remainder of the appendage while this appendage in *A. arcuatus* has an apical portion sharply angled and ornamented with strong denticles. The proximal outer spine of the third endopodal segment of the second leg and the spines of the third endopodal segment of leg 4 of the male in *A. concinnus* are smooth and obtuse. These spines in *A. arcuatus* are denticulated. Also, *A. concinnus* (female: 2.90 mm long; Stock et al. 1963) is larger than *A. arcuatus* (female: 1.78 mm long).

Anthessius pleurobrancheae is the species that is geographically closest to the type locality of the new species. Although the original description of Della Valle (1880) is poor there are some apparent differences to *A. arcuatus*. These features are the absence of spines in leg 5: "Il piede del quinto paio sono piú allungati dell altro *Anthessius* (Referred to *Anthessius solenocurti* Della Valle, 1880), e muniti non de spine, ma di setole" (Della Valle 1880:58); the ratio of the length to the width of leg 5 is higher in *A. pleurobrancheae* (2.75:1) than in *A. arcuatus* (2.3:1).

Detailed examination of new specimens of *Anthessius* collected in Napoles (the type-locality) will permit clarification of the taxonomic status of *Anthessius pleurobrancheae* as well as establishing differences among its congeners, associated with notaspideans.

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